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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/615,915	07/10/2003	Yohei Yamazawa	227430US26	9540
22850	7590	09/22/2005	EXAMINER	
OBLON, SPIVAK, MCCLELLAND, MAIER & NEUSTADT, P.C. 1940 DUKE STREET ALEXANDRIA, VA 22314			DHINGRA, RAKESH KUMAR	
			ART UNIT	PAPER NUMBER
			1763	

DATE MAILED: 09/22/2005

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No. 10/615,915	Applicant(s) YAMAZAWA ET AL.	
	Examiner Rakesh K. Dhingra	Art Unit 1763	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 03 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 22 August 2005.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-40 is/are pending in the application.
 4a) Of the above claim(s) 2,5,7-9,21-25 and 31-40 is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1,3,4,6,10-20 and 26-30 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☒ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 10 July 2003 is/are: a) ☒ accepted or b) ☐ objected to by the Examiner.
 Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
 Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
 a) ☒ All b) ☐ Some * c) ☐ None of:
1. ☒ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. _____.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- * See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- | | |
|----------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892) | 4) <input type="checkbox"/> Interview Summary (PTO-413)
Paper No(s)/Mail Date. _____ |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948) | 5) <input type="checkbox"/> Notice of Informal Patent Application (PTO-152) |
| 3) <input checked="" type="checkbox"/> Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)
Paper No(s)/Mail Date <u>7/10/03</u> . | 6) <input type="checkbox"/> Other: _____ |

DETAILED ACTION

Election/Restrictions

Applicant's election with traverse of Invention of Group I (Claims 1-31) in the reply filed on 8/22/05 is acknowledged. Further applicant has also elected with traverse Species 4 (Figures 18, 30) and indicated Claims 1,3,4, 6,10-20 and 26-30 as reading on the elected species. The traversal is on the grounds that claims of the application appear to be part of an overlapping search area and would not place a serious burden on the examiner. This is not found persuasive because:

- a) inventions of Group I (apparatus) and Group II (process) pertain to different class of search and;
- b) the technical features of the species are mutually exclusive resulting in separate search required for each species.

The requirement is still deemed proper and is therefore made FINAL.

Specification

The disclosure is objected to because of the following informalities:

- 1) Page 28, lines 11, 14: "capacitor 55" does not match with "coil 55" shown in Fig. 7C;
- 2) Page 28, line 16: "fixed capacitor 55" does not match with "fixed coil 55" shown in Fig. 7C;
- 3) Page 43, line 7: "fixed capacitor 52" does not match with "variable capacitor 52" shown in Figure 15;
- 4) Page 49, line 27: it is suggested to verify if "second harmonic" is correct;
- 5) Page 50, line 4: it is suggested to verify if "second harmonic" is correct;

6) Page 50, lines 23, 24: it is suggested to verify if "A3" and "B4" are correct;

7) Page 54, line 14: "capacitors 88A, 88B, 88C" do not match with Fig. 25A;

Appropriate correction is required.

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order for the examiner to consider the applicability of 35 U.S.C. 103(c) and potential 35 U.S.C. 102(e), (f) or (g) prior art under 35 U.S.C. 103(a).

Claims 1, 3, 4 are rejected under 35 U.S.C. 103(a) as being unpatentable over Sato et al (US Patent No. 6,199,505) in view of Patrick et al (US Patent No. 5,474,648).

Regarding Claim 1: Sato et al teach an apparatus (Figures 1,3) which performs a plasma process on a target substrate 66 by using plasma, comprising:

an airtight process chamber 40a, which accommodates the target substrate;

a gas supply system 52, which supplies a process gas into the process chamber;

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an exhaust system 64 (as shown in Figure 1), which exhausts an interior of the process, chamber and sets the interior the process chamber to a vacuum state;

first and second electrodes 78, 54a arranged in the process chamber to oppose each other, an RF field which turns the process gas into plasma by excitation being formed between the first and second electrodes;

first and second RF power supplies 86, 62 connected to the first and second electrodes through matching circuits 84, 60 supply RF power, the matching circuits serving to perform input impedance matching relative to the RF power (Column 4, lines 40-63 and Column 8, lines 5- 50);

Sato et al do not teach an impedance setting section and controller.

Patrick et al teach an apparatus (Figure 2A) that has an impedance matching network 120 connected to a RF sensor (part of impedance setting section) 202,

which is connected through an interconnection, to an electrode (a predetermined member) 112 to be electrically coupled with the plasma process and the sensor

measures RF parameters (includes chamber impedance), and a computer system

(controller) 204 uses the signal from the sensor for dynamic control of the RF power and the matching network automatically adjusts the impedance to produce a match between

the RF generator and the plasma chamber. Patrick et al also teach that the control

profiles for each process may be stored in the software program for appropriate control of the process (Column 4, lines 1-67, Column 6, line 60 to Column 7, lines 1-60).

Therefore it would have been obvious to one of ordinary skill in the art at the time of the invention to use RF sensor and controller (impedance setting section and controller) as

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taught by Patrick et al in the apparatus of Sato et al to provide automatic monitoring and control of the plasma process.

Regarding Claims 3, 4: Patrick et al teach that preset control profiles for each process can be stored in the software program in advance and the apparatus results in improved planar uniformity of the plasma process on the target substrate. Patrick et al further teach that the dynamic control of RF parameters as per his invention results in increased repeatability (stability) of the plasma process (Column 3, lines 55-60 and Column 5, lines 15-25).

Claim 6 is rejected under 35 U.S.C. 103(a) as being unpatentable over Sato et al (US Patent No. 6,199,505) in view of Patrick et al (US Patent No. 5,474,648) as applied to Claim 1 and further in view of Collins et al (US Patent No. 6,252,354).

Regarding Claim 6: Sato et al in view of Patrick et al teach all limitations of the claim including that variable capacitors 106, 108 of the impedance matching network 120 (Patrick et al) may be automatically adjusted (continuously varying element) in response from sensor 202 to enable control impedance.

Patrick et al do not teach impedance control stepwise by switching a plurality of fixed elements.

Collins et al teach an apparatus (Figures 5, 6) that uses plurality of switches 520, 520' which can be closed in different combinations to provide choice of resistive matching ranges to facilitate impedance matching and that various inductive and capacitive elements may be fixed or variable (Column 10, line 52 to Column 11, line 37).

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Therefore it would have been obvious to one of ordinary skill in the art at the time of the invention to use stepwise control of impedance as taught by Collins et al in the apparatus of Sato et al in view of Patrick et al to provide further optimization of plasma parameters.

Claims 10-13, 26-29 are rejected under 35 U.S.C. 103(a) as being unpatentable over Sato et al (US Patent No. 6,199,505) in view of Patrick et al (US Patent No. 5,474,648) and further in view of Parsons (US Patent No. 6,884,635).

Regarding Claims 10, 12, 26, 28: Sato et al in view Patrick et al teach all limitations of the claim (as explained above) except harmonic content in the RF component.

Parsons teaches an apparatus (Figures 1, 5) that has a control system 184 that dynamically changes the matching network impedance to match the plasma load impedance. Parsons further teaches that the apparatus has means for reflecting higher harmonics back into plasma rather than dissipating it (Column 7, line 22 to Column 8, line 12).

Therefore it would have been obvious to one of ordinary skill in the art at the time of the invention to use impedance matching means for the harmonics in the RF component as taught by Parsons in the apparatus of Sato et al in view of Patrick et al to efficiently use the higher harmonic frequencies in generating plasma.

Regarding Claim 13: Patrick et al teach that the sensor 202 and controller 204 (impedance setting section) are connected to the electrodes and the apparatus (Patrick et al, Figure 2A) provides dynamic control of RF power parameters being delivered to plasma chamber (Column 3, lines 55-65).

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Regarding Claim 11, 27: Patrick et al teach that matching network 120 automatically adjusts to produce an impedance match based on a signal given by sensor 202 to power controller 204. Patrick et al also teach that values of coil 110 and variable capacitors are selectable/optimizable (includes input impedance to be set at not less than twice the RF load impedance of plasma and process chamber) depending on process limitations (Column 7, lines 4-20).

Further it has been held in courts (Case Law) as follows:

It would have been obvious to one having ordinary skill in the art to have determined the optimum value of a cause effective variable such as through routine experimentation in the absence of a showing of criticality. *In re Woodruff*, 16 USPQ2d 1934, 1936 (Fed. Cir. 1990).

Regarding Claim 29: Sato et al teach that frequency of first RF power source 86 is higher (30-300 MHz) than that of second RF power source 62 (0.3 to 30 MHz) [Column 8, lines 30-40].

Claim 14 is rejected under 35 U.S.C. 103(a) as being unpatentable over Sato et al (US Patent No. 6,199,505) in view of Patrick et al (US Patent No. 5,474,648) and Parsons (US Patent No. 6,884,635) as applied to Claim 12 and further in view of Shan et al (US Pub. No.2001/0009139).

Regarding Claim 14: Sato et al in view of Patrick et al and Parsons teach all limitations of the claim except that predetermined member is focus ring.

Shan et al teach an apparatus (Figure 2) that has matched RF power connected to Process kit (focus ring) 220 [Paragraphs 0029, 0035, 0040].

Therefore it would have been obvious to one of ordinary skill in the art at the time of the invention to select focus ring as predetermined member as taught by Shan et al in the

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apparatus of Sato et al in view of Patrick et al and Parsons to improve plasma uniformity (Paragraph 0011).

Claim 15 is rejected under 35 U.S.C. 103(a) as being unpatentable over Sato et al (US Patent No. 6,199,505) in view of Patrick et al (US Patent No. 5,474,648) and Parsons (US Patent No. 6,884,635) as applied to Claim 12 and further in view of Hendricks et al (US Patent No. 4,340,461).

Regarding Claim 15: Sato et al in view of Patrick et al and Parsons teach all limitations of the claim except that predetermined member is rectifying (baffle) plate.

Hendericks et al teach an apparatus that has a conductive baffle (rectifying) plate 41 (Figures 1, 2) connected to anode (upper electrode) 3 which is connected to RF power source [Column 4, lines 1-50 and Column 7, lines 39-45]. As already explained above, Sato et al in view of Patrick et al and Parson teach plasma system where one of the electrodes is connected to matching network and impedance setting section with a controller for matching of impedance.

Therefore it would have been obvious to one of ordinary skill in the art at the time of the invention to use baffle plate as predetermined member and connected to RF source (through one of the electrode-anode) as taught by Hendericks et al in the apparatus of Sato et al in view of Patrick et al and Parsons to increase process uniformity (Column 6, lines 3-11).

Claim 16 is rejected under 35 U.S.C. 103(a) as being unpatentable over Sato et al (US Patent No. 6,199,505) in view of Patrick et al (US Patent No. 5,474,648) and

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Parsons (US Patent No. 6,884,635) as applied to Claim 12 and further in view of Collins (US Patent No. 6,252,354).

Regarding Claim 16: Sato et al in view of Patrick et al and Parsons teach all limitations of the claim as explained above except impedance control stepwise by switching a plurality of fixed elements.

Collins et al teach an apparatus (Figures 5, 6) that uses plurality of switches 520, 520' which can be closed in different combinations to provide choice of resistive matching ranges to facilitate impedance matching and that various inductive and capacitive elements may be fixed or variable (Column 10, line 52 to Column 11, line 37).

Therefore it would have been obvious to one of ordinary skill in the art at the time of the invention to use stepwise control of impedance as taught by Collins et al in the apparatus of Sato et al in view of Patrick et al and Parsons to provide further optimization of plasma parameters.

Claims 17-20 are rejected under 35 U.S.C. 103(a) as being unpatentable over Sato et al (US Patent No. 6,199,505) in view of Patrick et al (US Patent No. 5,474,648) and Parsons (US Patent No. 6,884,635) as applied to Claim 12 and further in view of Hilliker (US Patent No. 6,631, 693).

Regarding Claim 17: Sato et al in view of Patrick et al and Parsons teach all limitations of the claim except filter in impedance setting unit to resonate at higher harmonics.

Hilliker teaches an apparatus (Filter as per Figures 2, 6) 601 that can allow frequencies of interest (includes higher harmonics) to be delivered to plasma while absorbing unwanted frequencies coming from plasma (Column 8, line 25 to Column 9, line 5).

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Therefore it would have been obvious to one of ordinary skill in the art at the time of the invention to use filter circuit as taught by Hilliker in the apparatus of Sato et al in view of Patrick et al and Parsons to obtain desired process results by using frequencies of interest.

Regarding Claim 18: Hilliker teaches that filter circuits (Figures 1) have a resistance (that is impedance, since reactive component is very low) of 50 ohm to enable dissipate energy at other than desired frequencies (Column 4, lines 26-53).

Regarding Claims 19, 20: Hilliker teaches that Filter circuit 601 (Figure 6) include a high pass filter 631 and a low pass filter 621 which can be set to cut any desired frequency including fundamental frequency component (Column 8, lines 25-67).

Claim 30 is rejected under 35 U.S.C. 103(a) as being unpatentable over Sato et al (US Patent No. 6,199,505) in view of Patrick et al (US Patent No. 5,474,648) and Parsons (US Patent No. 6,884,635) as applied to Claims 26-29 and further in view of Nakano et al (US Patent No. 6,270,618).

Sato et al in view of Patrick et al and Parsons teach all limitations of the claim except frequency of first RF power being lower than that of second RF power.

Nakano et al teach an apparatus (Figure 11) that has first RF power supply 1 (13.56 MHz) connected to upper electrode 4 and second RF power supply 15 (100 MHz) connected to susceptor 8 and where the system has a band eliminator 61b that can be set to resonance to select only a specific frequency to be supplied to susceptor (Column 1, lines 10-65).

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Therefore it would have been obvious to one of ordinary skill in the art at the time of the invention to use frequency configuration for the electrodes as taught by Nishikawa et al in the apparatus of Sato et al in view of Patrick et al and Parsons to enable generate plasma as per process limitations.

Conclusion

The prior art made of record and not relied upon is considered pertinent to applicant's disclosure.

Hirose (US Patent No. 6,485,602) teach an apparatus (Figure 7) that includes two filter circuits 40 and 41 for attenuating the high frequency power flowing in from the other electrode and a third filter circuit 42 to reduce the sputtering by adjusting the circuit constants.

Patrick et al (US Patent No. 6,174,450) teach an apparatus (Figure 4b) that has feedback circuits 100, 102 in the RF supply lines of the two electrodes 40, 48 to monitor and control parameters of the RF signal to ensure matching between RF supply and the plasma parameters.

Sorensen et al (US Patent No. 5,815,047) teach an apparatus (Figure 3) that has tuning capacitors 30, 32 and a controller (Phase/Magnitude Detector) 40 for monitoring and controlling the impedance as per fluctuations in plasma conditions.

Windhorn et al (US Patent No. 6,812,646) teach an apparatus (Figure 1) in which harmonics in the RF power are absorbed by an absorbing transmission line 6 having frequency dependent attenuation characteristics.

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Any inquiry concerning this communication or earlier communications from the examiner should be directed to Rakesh K. Dhingra whose telephone number is (571)-272-5959. The examiner can normally be reached on 8:30 -6:00 (Monday - Friday). If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Parviz Hassanzadeh can be reached on (571)-272-1435. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).



Rakesh Dhingra



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